Chapter 19*A* – Concrete

2001 CBC	PROPOSED ADOPTION	OSHPD		DSA-SS	Comments
		1	4		
	Adopt entire chapter without amendments				
	Adopt entire chapter with amendments listed below	X	X	X	
	Adopt only those sections listed below				
	1901A.1.1 CA	X	X	X	
	1901A.1.2 CA	X	X	X	
	1903A.1	X	X	X	
1903A.3.2	*1903A.3 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1903A.5.2	*1903A.4 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1903A.6.6 CA	*1903A.5 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.1.3	*1905A.1.1*	X	X	X	Relocated existing California Building Standards into IBC format
1905.3.3.2, Item 7, CA	*1905A.2*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.6.1.3	*1905A.6.2*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.6.1.1	*1905A.6.2.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.8.3	*1905A.8*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.10.10 CA	*1905A.10.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1905A.12.4 CA	*1905A.12*	X	X	X	Relocated existing California Building Standards into IBC format
1906A.2.1	*1906A.2*	X	X	X	Relocated existing California Building Standards into IBC format
1906A.3.13 CA	*1906A.3.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1906A.3.14 CA	*1906A.3.2 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1906A.4.3	*1906A.4*	X	X	X	Relocated existing California Building Standards into IBC format
1906A.4.7 CA	*1906A.4.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1907A.5.5 CA	*1907A.5.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format

1907A.7.1	*1907A.7.1*	X	X	X	Relocated existing California Building Standards into IBC format
	1908A.1	X	X	X	
1908A.11.5 CA	*1908A.1.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1908A.11.6 CA	*1908A.1.2 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1908A.11.9 CA	*1908A.1.3 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1910A.5.3	*1908A.1.4 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1912A.14.3.6	*1908A.1.5 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.2.6	*1908A.1.7 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.3.5	*1908A.1.8 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.3.8	*1908A.1.9 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.5	*1908A.1.10 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.6.1 CA	*1908A.1.11 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1914A.10 CA	*1908A.1.12 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1915A.2.1	*1908A.1.13 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1915A.2.2.2	*1908A.1.14 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1915A.8.3.2	*1908A.1.15 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1916A.3.3 CA	*1908A.1.16 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1916A.11 CA	*1908A.1.17 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1916A.12 CA	*1908A.1.18 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1917A.5.1.1, 1917A.5.1.1	*1908A.1.19 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.2.3.2 CA	*1908A.1.20 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.2.4.2 CA	*1908A.1.21 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.2.7 CA	*1908A.1.22 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.6.4 CA	*1908A.1.23 CA*	X	X	X	Relocated existing California Building Standards into IBC format

1918A.9.2.2	*1908A.1.24 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.9.2.3	*1908A.1.25 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.12.7 CA	*1908A.1.26 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.19.5 CA	*1908A.1.27 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1918A.21 CA	*1908A.1.28 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.2.1.2	*1908A.1.30CA*	X	X	X	Relocated existing California Building Standards into IBC format
	1908A.1.32	X	X	X	
1921A.2.5.5	*1908A.1.33 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.4.4.1 CA	*1908A.1.34 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.4.4.7 CA	*1908A.1.35 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.5.4.5 CA	*1908A.1.36 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.6.2.2	*1908A.1.37 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.6.6.3.2 CA	*1908A.1.38 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.6.12	*1908A.1.41 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1921A.6.6.4 CA	*1908A.1.42 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1922A.1 CA	*1909A.1*	X	X	X	Relocated existing California Building Standards into IBC format
	1912A.1	X	X	X	
1924A.1	*1913A.1*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.7	*1913A.7*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.10	*1913A.10*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.10	*1913A.10.2*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.12	*1913A.11*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.13	*1913A.12*	X	X	X	Relocated existing California Building Standards into IBC format
1924A.14	*1913A.13*	X	X	X	Relocated existing California Building Standards into IBC format

	1914A.1	X	X	X	
1929A.1 CA	*1916A.1 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.2 CA	*1916A.2 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.3 CA	*1916A.3 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.4 CA	*1916A.6 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.5 CA	*1916A.8 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.6 CA	*1916A.11 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1929A.7 CA	*1916A.13 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1923A.3.5	*1916A.8 CA*	X	X	X	Relocated existing California Building Standards into IBC format
1930A CA	*1917A CA*	X	X	X	Relocated existing California Building Standards into IBC format

REPEAL OF EXISTING CALIFORNIA AMENDMENTS IN PART OR IN WHOLE THAT ARE NO LONGER NECESSARY AS FOLLOWS:

2001 CBC DIVISION I – GENERAL

~~2001 CBC SECTION 1900A – GENERAL:~~ Repeal all amendments in this section.

2001 CBC DIVISION II

~~2001 CBC SECTION 1901A – SCOPE:~~ Repeal all amendments in this section.

~~2001 CBC SECTION 1902A – DEFINITION:~~ Repeal all amendments in this section.

2001 CBC SECTION 1903A – SPECIFICATIONS FOR TESTS AND MATERIALS: Repeal all amendments in following sections.

~~1903A.1.1,1903A.1.4, 1903A.3.2~~ including all subsections, ~~1903A.6.1,1903A.6.9, 1903A.8~~ and ~~1903A.9.~~

~~2001 CBC SECTION 1904A – DURABILITY REQUIREMENTS:~~ Repeal all amendments in this section.

2001 CBC SECTION 1905A – CONCRETE QUALITY, MIXING AND PLACING: Repeal all amendments in following sections.

~~1905A.1.1, 1905A.1.3, 1905A.2.3, 1905A.3, 1905A.3.1.1, 1905A.3.1.2, 1905A.3.2.2, 1905A.3.3.2~~ item # ~~4, 1905A.4~~ including all subsections, ~~1905A.5~~ including all subsections, 1905A.6.1.3, ~~905A.6.2.1~~ including all subsections, ~~1905A.6.2.2~~ including all subsections, ~~1905A.6.2.3, 1905A.6.3.1, 1905A.6.3.2, 1905A.6.4~~ including all subsections,~~ 1905A.7.1~~ including all subsections, ~~1905A.8.3, 1905A.10.4~~ and ~~1905A.10.9.~~

2001 CBC SECTION 1906A – FORMWORK, EMBEDDED PIPES AND CONSTRUCTION JOINTS: Repeal all amendments in following sections.

~~1906A.2.2.1, 1906A.3.1~~ and ~~1906A.3.5~~

2001 CBC SECTION 1907A – DETAILS OF REINFORCEMENT: Repeal all amendments in following sections.

~~*1907A.3.1, 1907A.3.2, 1907A.5.2* and *1907A.10.5.6.*~~

2001 CBC SECTION 1908A – ANALYSIS AND DESIGN: Repeal all amendments in following sections.

~~*1908A.11, 1908A.11.5.2, 1908A.11.5.3, 1908A.11.6.1* and *1908A.11.6.2.*~~

~~2001 CBC SECTION 1909A – STRENGTH AND SERVICEABILITY REQUIREMENTS:~~ Repeal all amendments in this section.

~~2001 CBC SECTION 1911A – SHEAR AND TORSION:~~ Repeal all amendments in this section.

2001 CBC SECTION 1914A – WALLS: Repeal all amendments in following sections.

~~*1914A.2.3* and *1914A.9.*~~

2001 CBC SECTION 1915A – FOOTINGS: Repeal all amendments in following sections.

~~*1915A.2.2* including all subsection and *1915A.11.*~~

2001 CBC SECTION 1916A – PRECAST CONCRETE: Repeal all amendment in the following section.

~~*1916A.7* including all subsection.~~

2001 CBC SECTION 1918A – PRESTRESSED CONCRETE: Repeal all amendment in the following section.

~~*1918A.18.1* and *1918A.19.2.*~~

~~2001 CBC SECTION 1920A – SHEAR AND TORSION:~~ Repeal all amendments in this section.

2001 CBC SECTION 1921A – REINFORCED CONCRETE STRUCTURES RESISTING FORCES INDUCED BY EARTHQUAKE MOTIONS: Repeal all amendments in following section.

~~*1921A.0, 1921A.2.1.3, 1921A.2.1.7, 1921A.2.4.1, 1921A.4.3.2, 1921A.6.6.5.2, 1921A.7.2.3* and *1921A.8.*~~

2001 CBC DIVISION III – DESIGN STANDARD FOR ANCHORAGE TO CONCRETE.

2001 CBC SECTION 1923A – ANCHORAGE TO CONCRETE: Repeal all amendments in following section.

~~*1923A.1, 1923A.2*, and *1923A.3* including all subsections except 1923A.3.5.~~

2001 CBC DIVISION IV – DESIGN AND CONSTRUCTION STANDARD FOR SHORTCRETE.

2001 CBC SECTION 1924A – SHORTCRETE: Repeal all amendments in following section.

~~*1924A.4* and *1924A.11.1*.~~

~~2001 CBC DIVISION V – DESIGN STANDARD FOR REINFORCED GYPSUM CONCRETE:~~ Repeal all amendments in this division.

~~2001 CBC DIVISION VII – UNIFIED DESIGN PROVISIONS:~~ Repeal all amendments in this division.

2001 CBC CHAPTER 19A - TABLES: Repeal all amendments in following tables.

~~*Table's 19A-A-8* and *19-A-D*~~.

EXPRESS TERMS

Italics are used for text within Sections 1903A through 1908A of this code to indicate provisions that differ from ACI 318. State of California amendments are shown in italics and underlined.

SECTION 1901A - GENERAL

1901A.1 Scope. The provisions of this chapter shall govern the materials, quality control, design and construction of concrete used in structures.

1901A.1.1 Application. *The scope of application of Chapter 19A is as follows:*

1. Applications listed in Section 109.2, regulated by the Division of the State Architect-Structural Safety (DSA-SS). These applications include public elementary and secondary schools, community colleges and state-owned or state-leased essential services buildings.

2. Applications listed in Section 110.1, and 110.4, regulated by the Office of Statewide Health Planning and Development (OSHPD). These applications include hospitals, skilled nursing facilities, intermediate care facilities and correctional treatment centers.

Exception [For OSHPD 2]: *Single-story Type V skilled nursing or intermediate care facilities utilizing wood-frame or light-steel-frame construction as defined in Health and Safety Code Section 129725, which shall comply with CBC Chapter 16 and any applicable amendments therein.*

1901A.1.2 Amendments in this chapter. *DSA - SS and OSHPD adopt this chapter and all amendments.*

Exception: *Amendments adopted by only one agency appear in this chapter preceded with the appropriate acronym of the adopting agency, as follows:*

1. Division of the State Architect - Structural Safety:

[DSA-SS] - *For applications listed in Section 109.2*

2. Office of Statewide Health Planning and Development:

[OSHPD 1] *- For applications listed in Section 110.1*

[OSHPD 4] *- For applications listed in Section 110.4*

1901A.2 Plain and reinforced concrete. Structural concrete shall be designed and constructed in accordance with the requirements of this chapter and ACI 318 as amended in Section 1908A of this code. Except for the provisions of Sections 1904A and 1910A, the design and construction of slabs on grade shall not be governed by this chapter unless they transmit vertical loads or lateral forces from other parts of the structure to the soil.

1901A.3 Source and applicability. The format and subject matter of Sections 1902A through 1907A of this chapter are patterned after, and in general conformity with, the provisions for structural concrete in ACI 318.

1901A.4 Construction documents. The construction documents for structural concrete construction shall include:

1. The specified compressive strength of concrete at the stated ages or stages of construction for which each concrete element is designed.
2. The specified strength or grade of reinforcement.
3. The size and location of structural elements, reinforcement, and anchors.
4. Provision for dimensional changes resulting from creep, shrinkage and temperature.
5. The magnitude and location of prestressing forces.

6. Anchorage length of reinforcement and location and length of lap splices.

7. Type and location of mechanical and welded splices of reinforcement.

8. Details and location of contraction or isolation joints specified for plain concrete.

9. Minimum concrete compressive strength at time of posttensioning.

10. Stressing sequence for posttensioning tendons.

11. For structures assigned to Seismic Design Category D, E or F, a statement if slab on grade is designed as a structural diaphragm (see Section 21.10.3.4 of ACI 318).

1901*A*.5 Special inspection. The special inspection of concrete elements of buildings and structures and concreting operations shall be as required by Chapter 17*A*.

SECTION 1902*A* - DEFINITIONS

1902*A*.1 General. The words and terms defined in ACI 318 shall, for the purposes of this chapter and as used elsewhere in this code for concrete construction, have the meanings shown in ACI 318.

SECTION 1903*A* - SPECIFICATIONS FOR TESTS AND MATERIALS

1903*A*.1 General. Materials used to produce concrete, concrete itself and testing thereof shall comply with the applicable standards listed in ACI 318. *Where required, special inspections and tests shall be in accordance with Chapter 17A and Section 1916A.*

1903*A*.2 Glass fiber reinforced concrete. *Glass fiber reinforced concrete (GFRC) and the materials used in such concrete shall be in accordance with the PCI MNL 128 standard.*

1903A.3 Modify ACI 318 Section 3.3.2 by adding the following:

(Relocated from 1903A.3.2, 2001 CBC) Aggregate size limitations waiver shall be approved by the enforcement agency.

Evidence that the aggregate used is not reactive in the presence of cement alkalis may be required by the enforcement agency. If new aggregate sources are to be used or if past experience indicates problems with existing aggregate sources, test the aggregate for potential reactivity according to ASTM C 289 to determine potential reactivity in the presence of cement.

If the results of the test are other than innocuous, selected concrete proportions using the aggregate (see Section 1905A.2) shall be tested in accordance with ASTM C 1567. If the results of this test indicate an expansion greater than 0.10 percent at 16-days age, provide mitigation with one of the cementitious material systems noted below such that an expansion of less than 0.10 percent at 16-days age is obtained:

1. Low-alkali portland cement containing not more than 0.6 percent total alkali when calculated as sodium oxide, as determined by the method given in ASTM C 114.

2. Blended hydraulic cement, Type IS or IP, conforming to ASTM C 595, except that Type IS cement shall not contain less than 40 percent slag constituent.

3. Replacement of not less than 15 percent by weight of the portland cement used by a mineral admixture conforming to ASTM C 618 for Class N or F materials (Class C is not permitted).

4. Replacement of not less than 40 percent by weight of the portland cement used by a ground granulated blast-furnace slag conforming to ASTM C 989.

1903A.4 Welding of reinforcing bars - Modify ACI 318 Section 3.5.2 by adding the following:

(Relocated from 1903A.5.2, 2001 CBC) If mill test reports are not available, chemical analysis shall be made of bars representative of the bars to be welded. Bars with a carbon equivalent (C.E.) above 0.75 shall not be welded. Welding shall not be done on or within two bar diameters of any bent portion of a bar that has been bent cold. Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the structural engineer and approved by the enforcement agency per approved procedures.

1903A.5 Fly Ash - Replace ACI 318 Section 3.6.6 as follows:

(Relocated from 1903A.6.6, 2001 CBC) Fly ash or other pozzolan can be used as a partial substitute for ASTM C 150 portland cement, as follows:

1. *Fly ash or other pozzolan shall conform to ASTM C 618 for Class N or Class F materials (Class C is not permitted), and*

2. *More than 15 percent by weight of fly ash or other pozzolans shall be permitted to be substituted for ASTM C 150 portland cement if the mix design is proportioned ~~by Method B or C~~ per Section 1905A.3. See Section 1904A for durability requirements.*

3. *More than 40 percent by weight of ground-granulated blast-furnace slag conforming to ASTM C 989 shall be permitted to be substituted for ASTM C 150 portland cement if the mix design is proportioned ~~by Method B or C~~ per Section 1905A.3. See Section 1904A for durability requirements.*

SECTION 1904A - DURABILITY REQUIREMENTS

1904A.1 Water-cementitious materials ratio. Where maximum water-cementitious materials ratios are specified in ACI 318, they shall be calculated in accordance with ACI 318, Section 4.1.

1904A.2 Freezing and thawing exposures. Concrete that will be exposed to freezing and thawing, deicing chemicals or other exposure conditions as defined below shall comply with Sections 1904A.2.1 through 1904A.2.3.

1904A.2.1 Air entrainment. Concrete exposed to freezing and thawing or deicing chemicals shall be air entrained in accordance with ACI 318, Section 4.2.1:

1904A.2.2 Concrete properties. Concrete that will be subject to the following exposures shall conform to the corresponding maximum water-cementitious materials ratios and minimum specified concrete compressive strength requirements of ACI 318, Section 4.2.2:

1. Concrete intended to have low permeability where exposed to water;

2. Concrete exposed to freezing and thawing in a moist condition or deicer chemicals; or

3. Concrete with reinforcement where the concrete is exposed to chlorides from deicing chemicals, salt, salt water, brackish water, seawater or spray from these sources.

Exception: *For occupancies and appurtenances thereto in Group R occupancies that are in buildings less than four stories in height, normal-weight aggregate concrete shall comply with the requirements of Table 1904A.2.2 based on the weathering classification (freezing and thawing) determined from Figure 1904A.2.2.*

In addition, concrete exposed to deicing chemicals shall conform to the limitations of Section 1904A.2.3.

TABLE 1904A.2.2 MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'_c)

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'_c at 28 days, psi)		
	Negligible exposure	Moderate exposure	Severe exposure
Basement walls[c] and foundations not exposed to the weather	2,500	2,500	2,500[a]
Basement slabs and interior slabs on grade, except	2,500	2,500	2,500[a]

garage floor slabs			
Basement walls[c], foundation walls, exterior walls and other vertical concrete surfaces exposed to the weather	2,500	3,000[b]	3,000[b]
Driveways, curbs, walks, patios, porches, carport slabs, steps and other flatwork exposed to the weather, and garage floor slabs	2,500	3,000[b, d]	3,500[b, d]

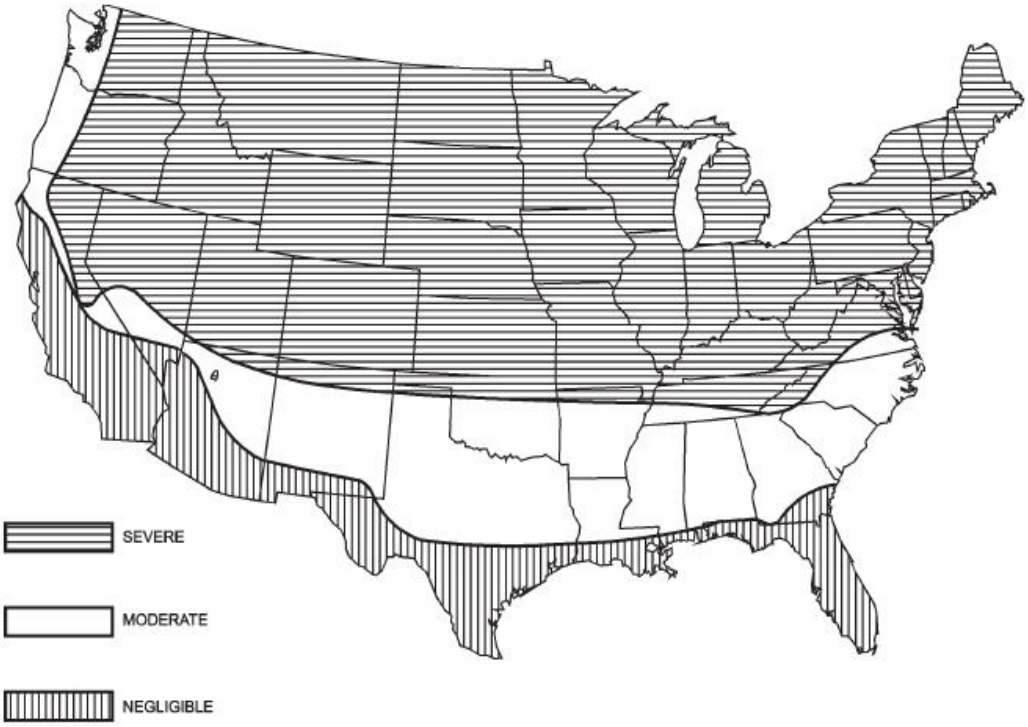
For SI: 1 pound per square inch = 0.00689 MPa.

a. Concrete in these locations that can be subjected to freezing and thawing during construction shall be of air-entrained concrete in accordance with Section 1904A.2.1.

b. Concrete shall be air entrained in accordance with Section 1904A.2.1.

c. Structural plain concrete basement walls are exempt from the requirements for exposure conditions of Section 1904A.2.2 (see Section 1909A.6.1).

d. For garage floor slabs where a steel trowel finish is used, the total air content required by Section 1904A.2.1 is permitted to be reduced to not less than 3 percent, provided the minimum specified compressive strength of the concrete is increased to 4,000 psi.



a. Lines defining areas are approximate only. Local areas can be more or less severe than indicated by the region classification.

b. A "severe" classification is where weather conditions encourage or require the use of deicing chemicals or where there is potential for a continuous presence of moisture during frequent cycles of freezing and thawing. A "moderate" classification is where weather conditions occasionally expose concrete in the presence of moisture to freezing and thawing, but where deicing chemicals are not generally used. A "negligible" classification is where weather conditions rarely expose concrete in the presence of moisture to freezing and thawing.

c. Alaska and Hawaii are classified as severe and negligible, respectively.

FIGURE 1904A.2.2 WEATHERING PROBABILITY MAP FOR CONCRETE[a, b, c]

1904A.2.3 Deicing chemicals. For concrete exposed to deicing chemicals, the maximum weight of fly ash, other pozzolans, silica fume or slag that is included in the concrete shall not exceed the percentages of the total weight of cementitious materials permitted by ACI 318, Section 4.2.3.

1904A.3 Sulfate exposures. Concrete that will be exposed to sulfate-containing solutions or soils shall comply with the maximum water-cementitious materials ratios, minimum specified compressive strength and be made with the appropriate type of cement in accordance with the provisions of ACI 318, Section 4.3.

1904A.4 Corrosion protection of reinforcement. Reinforcement in concrete shall be protected from corrosion and exposure to chlorides in accordance with ACI 318, Section 4.4.

SECTION 1905A CONCRETE QUALITY, MIXING AND PLACING

1905A.1 General. The required strength and durability of concrete shall be determined by compliance with the proportioning, testing, mixing and placing provisions of Sections 1905A.1.1 through 1905A.13.

1905A.1.1 Strength. Concrete shall be proportioned to provide an average compressive strength as prescribed in Section 1905A.3 and shall satisfy the durability criteria of Section 1904A. Concrete shall be produced to minimize the frequency of strengths below f'_c as prescribed in Section 1905A.6.3. *For concrete designed and constructed in accordance with this chapter, f'_c shall not be less than* *(Relocated from 1905A.1.3, 2001 CBC)* *3,000 psi (20.7MPa) except that 2,500 psi (17.2MPa) concrete may be used in the design of footings for light one-story wood- or steel-framed buildings or other minor structures.* ~~2,500 psi (17.22 MPa).~~ No maximum specified compressive strength shall apply unless restricted by a specific provision of this code or ACI 318. *Reinforced concrete with specified compressive strength higher than 8000 psi* ~~*may be considered with*~~ *shall require prior approval of structural design method and acceptance criteria acceptable to the enforcement agency.*

1905A.2 Selection of concrete proportions. Concrete proportions shall be determined in accordance with the provisions of ACI 318, Section 5.2.

(Relocated from 1905A.3.3.2, Item #7, 2001 CBC) *A registered civil engineer with experience in concrete mix design shall select the relative amounts of ingredients to be used as basic proportions of the concrete mixes proposed for use under this provision and testing shall be performed in a laboratory acceptable to the enforcement agency.*

1905A.3 Proportioning on the basis of field experience and / or trial mixtures. Concrete proportioning determined on the basis of field experience and / or trial mixtures shall be done in accordance with ACI 318, Section 5.3.

1905A.4 Proportioning without field experience or trial mixtures. Concrete proportioning determined without field experience or trial mixtures shall be done in accordance with ACI 318, Section 5.4.

1905A.5 Average strength reduction. As data become available during construction, it is permissible to reduce the amount by which the average compressive strength (f'_c) is required to exceed the specified value of f'_c in accordance with ACI 318, Section 5.5.

1905A.6 Evaluation and acceptance of concrete. The criteria for evaluation and acceptance of concrete shall be as specified in Sections 1905A.6.2 through 1905A.6.5.

1905A.6.1 Qualified technicians. Concrete shall be tested in accordance with the requirements in Sections 1905A.6.2 through 1905A.6.5. Qualified field testing technicians shall perform tests on fresh concrete at the job site, prepare specimens required for curing under field conditions, prepare specimens required for testing in the laboratory and record the temperature of the fresh concrete when preparing specimens for strength tests. Qualified laboratory technicians shall perform all required laboratory tests.

1905*A*.6.2 Frequency of testing. The frequency of conducting strength tests of concrete and the minimum number of tests shall be as specified in ACI 318, Section 5.6.2 *except as modified in Section 1905A.6.2.1.*

Exception: *(Relocated from 1905A.6.1.3, 2001 CBC) Not permitted by OSHPD and DSA-SS .* ~~When the total volume of a given class of concrete is less than 50 cubic yards (38 m^3), strength tests are not required when evidence of satisfactory strength is submitted to and approved by the building official~~.

1905A.6.2.1 Sample Frequency - Replace ACI 318 Section 5.6.2.1 as follows:

5.6.2.1 *(Relocated from 1905A.6.1.1, 2001 CBC) Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards (345m^3) of concrete, or not less than once for each 2,000 square feet (186 m^2) of surface area for slabs or walls. Additional samples for seven-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.*

1905*A*.6.3 Strength test specimens. Specimens prepared for acceptance testing of concrete in accordance with Section 1905*A*.6.2 and strength test acceptance criteria shall comply with the provisions of ACI 318, Section 5.6.3.

1905*A*.6.4 Field-cured specimens. Where required by the building official to determine adequacy of curing and protection of concrete in the structure, specimens shall be prepared, cured, tested and test results evaluated for acceptance in accordance with ACI 318, Section 5.6.4.

1905*A*.6.5 Low-strength test results. Where any strength test (see ACI 318, Section 5.6.2.4) falls below the specified value of f'_c, the provisions of ACI 318, Section 5.6.5, shall apply.

1905*A*.7 Preparation of equipment and place of deposit. Prior to concrete being placed, the space to receive the concrete and the equipment used to deposit it shall comply with ACI 318, Section 5.7.

1905*A*.8 Mixing. Mixing of concrete shall be performed in accordance with ACI 318, Section 5.8.

(Relocated from 1905A.8.3, 2001 CBC) The capacity of the mixer shall be such that it will handle one or more full sack batches. No split sack batches will be permitted, except when all materials are weighed.

1905*A*.9 Conveying. The method and equipment for conveying concrete to the place of deposit shall comply with ACI 318, Section 5.9.

1905*A*.10 Depositing. The depositing of concrete shall comply with the provisions of ACI 318, Section 5.10.

1905A.10.1 Consolidation in congested areas.

(Relocated from 1905A.10.10, 2001 CBC) Where conditions make consolidation difficult, or where reinforcement is congested, a mix design with smaller size aggregates, ~~batches of concrete adjusted to use smaller size aggregates than specified in the mix design~~ shall be used as approved by the architect, structural engineer and the enforcement agency.

1905*A*.11 Curing. The length of time, temperature and moisture conditions for curing of concrete shall be in accordance with ACI 318, Section 5.11.

1905*A*.12 Cold weather requirements. Concrete to be placed during freezing or near-freezing weather shall comply with the requirements of ACI 318, Section 5.12.

(Relocated from 1905A.12.4, 2001 CBC) When mixing concrete during ~~freezing or near freezing~~ cold weather, the mix shall have a temperature of at least 50°F (10.0°C), but not more than 90°F (32.2°C). The concrete shall be maintained at a temperature of at least 50°F (10.0°C) for not less than 72 hours after placing. When necessary, concrete materials shall be heated before mixing. Special precautions shall be taken for the protection of transit-mixed concrete to maintain a temperature of at least 50°F (10.0°C).

1905*A*.13 Hot weather requirements. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 5.13.

SECTION 1906*A* - FORMWORK, EMBEDDED PIPES AND CONSTRUCTION JOINTS

1906*A*.1 Formwork. The design, fabrication and erection of forms shall comply with ACI 318, Section 6.1.

1906*A*.2 Removal of forms, shores and reshores. The removal of forms and shores, including from slabs and beams (except where cast on the ground), and the installation of reshores shall comply with ACI 318, Section 6.2.

(Relocated from 1906A.2.1, 2001 CBC) No portion of the forming and shoring system may be removed less than 12 hours after placing. When stripping time is less than the specified curing time, measures shall be taken to provide adequate curing and thermal protection of the stripped concrete.

1906*A*.3 Conduits and pipes embedded in concrete. Conduits, pipes and sleeves of any material not harmful to concrete and within the limitations of ACI 318, Section 6.3, are permitted to be embedded in concrete with approval of the registered design professional.

1906A.3.1 *(Relocated from 1906A.3.13, 2001 CBC)* ***Large Openings.*** *Openings larger than 12 inches (305 mm) in any dimension shall be detailed on the structural plans. Nothing in this section shall be construed to permit work in violation of fire and panic or other safety standards*

1906A.3.2 *(Relocated from 1906A.3.14, 2001 CBC)* ***Adequate Support.*** *Pipes and conduits shall be adequately supported and secured against displacement before concrete is placed.*

1906*A*.4 Construction joints. Construction joints, including their location, shall comply with the provisions of ACI 318, Section 6.4.

(Relocated from 1906A.4.3, 2001 CBC) ~~*as determined by the structural engineer and shall conform to the typical details.*~~ *Typical details and proposed locations of construction joints shall be indicated on the plans.*

1906A.4.1 *(Relocated from 1906A.4.7, 2001 CBC)* ***Surface Preparation.*** *The surface of all horizontal construction joints shall be cleaned and roughened by* ~~*removing the entire surface and*~~ *exposing clean aggregate solidly embedded in mortar matrix.*

In the event that the contact surface becomes coated with earth, sawdust, etc., after being cleaned, the entire surface so coated shall be recleaned.

SECTION 1907*A* - DETAILS OF REINFORCEMENT

1907*A*.1 Hooks. Standard hooks on reinforcing bars used in concrete construction shall comply with ACI 318, Section 7.1.

1907*A*.2 Minimum bend diameters. Minimum reinforcement bend diameters utilized in concrete construction shall comply with ACI 318, Section 7.2.

1907*A*.3 Bending. The bending of reinforcement shall comply with ACI 318, Section 7.3.

1907*A*.4 Surface conditions of reinforcement. The surface conditions of reinforcement shall comply with the provisions of ACI 318, Section 7.4.

1907*A*.5 Placing reinforcement. The placement of reinforcement, including tolerances on depth and cover, shall comply with the provisions of ACI 318, Section 7.5. Reinforcement shall be accurately placed and adequately supported before concrete is placed.

1907A.5.1 *(Relocated from 1907A.5.5, 2001 CBC)* ***Prestressing tendons.*** *Prestressing tendons shall be placed within plus or minus 1/4-inch (6.4mm) tolerance for member depths equal to and less than 8 inches (203 mm) and not to exceed the lesser of 3/8 inch (9.5 mm) or one third the minimum concrete cover for member depths greater than 8 inches (203 mm).*

1907A.6 Spacing limits for reinforcement. The clear distance between reinforcing bars, bundled bars, tendons and ducts shall comply with ACI 318, Section 7.6.

1907A.7 Concrete protection for reinforcement. The minimum concrete cover for reinforcement shall comply with Sections 1907A.7.1 through 1907A.7.7.

1907A.7.1 Cast-in-place concrete (nonprestressed). Minimum concrete cover shall be provided for reinforcement in nonprestressed, cast-in-place concrete construction in accordance with ACI 318, Section 7.7.1.

(Relocated from 1907A.7.1, Item #4, 2001 CBC) Concrete tilt-up panels cast against a rigid horizontal surface, such as a concrete slab, exposed to the weather shall have 1" (25 mm) concrete cover for No. 8 or smaller bar and 2" (51 mm) cover for No. 9 or larger bars.

1907A.7.2 Cast-in-place concrete (prestressed). The minimum concrete cover for prestressed and nonprestressed reinforcement, ducts and end fittings in cast-in-place prestressed concrete shall comply with ACI 318, Section 7.7.2.

1907A.7.3 Precast concrete (manufactured under plant control conditions). The minimum concrete cover for prestressed and nonprestressed reinforcement, ducts and end fittings in precast concrete manufactured under plant control conditions shall comply with ACI 318, Section 7.7.3.

1907A.7.4 Bundled bars. The minimum concrete cover for bundled bars shall comply with ACI 318, Section 7.7.4.

1907A.7.5 Corrosive environments. In corrosive environments or other severe exposure conditions, prestressed and nonprestressed reinforcement shall be provided with additional protection in accordance with ACI 318, Section 7.7.5.

1907A.7.6 Future extensions. Exposed reinforcement, inserts and plates intended for bonding with future extensions shall be protected from corrosion.

1907A.7.7 Fire protection. When this code requires a thickness of cover for fire protection greater than the minimum concrete cover specified in Section 1907A.7, such greater thickness shall be used.

1907A.8 Special reinforcement details for columns. Offset bent longitudinal bars in columns and load transfer in structural steel cores of composite compression members shall comply with the provisions of ACI 318, Section 7.8.

1907A.9 Connections. Connections between concrete framing members shall comply with the provisions of ACI 318, Section 7.9.

1907A.10 Lateral reinforcement for compression members. Lateral reinforcement for concrete compression members shall comply with the provisions of ACI 318, Section 7.10.

1907A.11 Lateral reinforcement for flexural members. Lateral reinforcement for compression reinforcement in concrete flexural members shall comply with the provisions of ACI 318, Section 7.11.

1907A.12 Shrinkage and temperature reinforcement. Reinforcement for shrinkage and temperature stresses in concrete members shall comply with the provisions of ACI 318, Section 7.12.

1907A.13 Requirements for structural integrity. The detailing of reinforcement and connections between concrete members shall comply with the provisions of ACI 318, Section 7.13, to improve structural integrity.

SECTION 1908A - MODIFICATIONS TO ACI 318

1908A.1 General. The text of ACI 318 shall be modified as indicated in Sections 1908A.1.1 through ~~1908.1.16~~ *1908A.1.47*.

~~**1908.1.1 ACI 318, Section 10.5.** *Modify ACI 318, Section 10.5, by adding new Section 10.5.5 to read as follows:*~~

~~*10.5.5 - In structures assigned to Seismic Design Category B, beams in ordinary moment frames forming part of the seismic-force-resisting system shall have at least two main flexural reinforcing bars continuously top and bottom throughout the beam and continuous through or developed within exterior columns or boundary elements.*~~

1908A.1.1 *(Relocated from 1908A.11.5, 2001 CBC)* ***Replace ACI 318 Section 8.11.5 as follows:***

8.11.5 - Permanent burned clay or concrete tile fillers shall be considered only as forms and shall not be included in the calculations involving shear or bending moments.

The thickness of the concrete slab on the permanent fillers shall be designed as described in ~~Section 1908A.11.6~~ ACI Section 8.11.6 as modified in Section 1908A.1.2.

~~**1908.1.2 ACI 318, Section 11.11.** Modify ACI 318, Section 11.11, by changing its title to read as shown below and by adding new Section 11.11.3 to read as follows:~~

~~*11.11 - Special provisions for columns.*~~

~~*11.11.3 - In structures assigned to Seismic Design Category B, columns of ordinary moment frames having a clear height-to-maximum-plan-dimension ratio of five or less shall be designed for shear in accordance with 21.12.3.*~~

1908A.1.2 *(Relocated from 1908A.11.6, 2001 CBC)* ***Replace ACI 318 Section 8.11.6 as follows:***

8.11.6 - Where removable forms or fillers are used, the thickness of the concrete slab shall not be less than one twelfth of the clear distance between joists and in no case less than 2 1/2 inches (64 mm). Such slab shall be reinforced at right angles to the joists with at least the amount of reinforcement required for flexure, considering load concentrations, if any, but in no case shall the reinforcement be less than that required by ~~Section 1907A.12~~ ACI 318 Section 7.12.

1908A.1.3 *(Relocated from 1908A.11.9, 2001 CBC)* ***Add Section 8.11.9 to ACI 318 as follows:***

8.11.9 Concrete bridging*. Concrete bridging shall be provided as follows: one near the center of spans for 20 to 30 feet (6096 mm to 9144 mm) spans and two near the third points of spans over 30 feet (9144 mm). Such bridging shall be either:*

(a) *A continuous concrete web having a depth equal to the joist and a width not less than 3 1/2 inches (89 mm) reinforced with a minimum of one No. 4 bar in the top and bottom; or*

(b) *Any other concrete element capable of transferring a concentrated load of 1,000 pounds (4.5 kN) from any joist to the two adjacent joists.*

Such bridging shall not be required in roof framing if an individual member is capable of carrying dead load plus a concentrated load of 1,500 pounds (6.7 kN) at any point.

1908A.1.4 *(Relocated from 1910A.5.3, 2001 CBC)* ***Modify ACI 318 Section 10.5.3 by adding the following:***

This ~~alternative~~ section shall not be used for members that resist seismic loads, except that reinforcement provided for foundation elements for one-story wood-frame or one-story light steel buildings need not be more than one-third greater than that required by analysis for all loading conditions.

1908A.1.5 *(Relocated from 1912A.14.3.6, 2001 CBC)* ***Add Section 12.14.3.6 to ACI 318 as follows:***

12.14.3.6 - Welded splices and mechanical connections shall maintain the clearance and coverage requirements of ACI Sections 7.6 and 7.7.

1908A.1.6 Modify ACI 318 Section 13.5.3.3 by adding the following:

Provision of ACI 318 Section 13.5.3.3 shall not be used, unless approved otherwise by the enforcement agent.

1908A.1.7 *(Relocated from 1914A.2.6, 2001 CBC)* ***Replace ACI 318 Section 14.2.6 as follows:***

14.2.6 - Walls shall be anchored to intersecting elements such as floors or roofs or to columns, pilasters, buttresses, and intersecting walls and footings with reinforcement at least equivalent to No. 4 bars at 12 inches (305 mm) on center for each layer of reinforcement.

1908A.1.8 *(Relocated from 1914A.3.5, 2001 CBC)* ***Replace ACI 318 Section 14.3.5 as follows****:*

14.3.5 - Vertical and horizontal reinforcement shall not be spaced farther apart than three times the wall thickness, nor 18 inches (457 mm). Unless otherwise required by the engineer, the upper- and lowermost horizontal reinforcement shall be placed within one half of the specified spacing at the top and bottom of the wall.

1908A.1.9 *(Relocated from 1914A.3.8, 2001 CBC)* ***Add Section 14.3.8 to ACI 318 as follows****:*

14.3.8 - The minimum requirements for horizontal and vertical steel of ACI 318 Sections 14.3.2 and 14.3.3 may be interchanged for precast panels which are not restrained along vertical edges to inhibit temperature expansion or contraction.

1908A.1.10 *(Relocated from 1914A.5, 2001 CBC)* ***ACI 318 Section 14.5 – Empirical design method:*** *Not permitted by OSHPD and DSA-SS.*

1908A.1.11 *(Relocated from 1914A.6.1, 2001 CBC)* ***Replace ACI 318 Section 14.6.1 as follows:***

14.6.1 - Nonbearing walls or nonbearing shear walls shall have a thickness of not less than 4 inches (102 mm) nor a thickness less than 1 / 30 of the shorter unsupported distance between vertical or horizontal stiffening elements.

Where walls are supported laterally by vertical elements, the stiffness of each vertical element shall exceed that of the tributary area of the wall.

1908A.1.12 *(Relocated from 1914A.10, 2001 CBC)* ***Modify ACI 318 by adding Section 14.9 as follows:***

14.9 ***- Foundation Walls.*** *Horizontal reinforcing of concrete foundation walls for wood-frame or light-steel buildings shall consist of the equivalent of not less than one No. 5 bar located at the top and bottom of the wall. Where such walls exceed 3 feet (914 mm) in height, intermediate horizontal reinforcing shall be provided at spacing not to exceed 2 feet (610 mm) on center. Minimum vertical reinforcing shall consist of No. 3 bars at 24 inches (610 mm) on center.*

Where concrete foundation walls or curbs extend above the floor line and support wood-frame or light-steel exterior, bearing or shear walls, they shall be doweled to the foundation wall below with a minimum of No. 3 bars at 24 inches (610 mm) on center. Where the height of the wall above the floor line exceeds 18 inches (457 mm), the wall above and below the floor line shall meet the requirements of ~~Section 1914A.3. See Section 1633A.2.12 for additional requirements.~~ ACI 318 Section 14.3.

1908A.1.13 *(Relocated from 1915A.2.1, 2001 CBC)* ***Modify ACI 318 Section 15.2.1 by adding the following:***

The appropriate induced reactions for strength design may be computed as those due to a factor of ~~1.5~~ 1.4 times the soil pressures from gravity load combinations and the seismic load combinations of Section ~~1612A.3~~ 1605A.3.

~~**1908.1.14 ACI 318,** Section 22.6. Modify ACI 318, Section 22.6, by adding new Section 22.6.7 to read:~~

~~*22.6.7 - Detailed plain concrete structural walls.*~~

~~*22.6.7.1 - Detailed plain concrete structural walls are walls conforming to the requirements of ordinary structural plain concrete walls and 22.6.7.2.*~~

~~*22.6.7.2 - Reinforcement shall be provided as follows:*~~

~~*(a) Vertical reinforcement of at least 0.20 square inch (129 mm2) in cross-sectional area shall be provided continuously from support to support at each corner, at each side of each opening and at the ends of walls. The continuous vertical bar required beside an opening is permitted to substitute for one of the two No. 5 bars required by 22.6.6.5.*~~

~~*(b) Horizontal reinforcement at least 0.20 square inch (129 mm2) in cross-sectional area shall be provided:*~~

~~*1. Continuously at structurally connected roof and floor levels and at the top of walls;*~~

~~*2. At the bottom of load-bearing walls or in the top of foundations where doweled to the wall; and*~~

~~*3. At a maximum spacing of 120 inches (3048 mm).*~~

~~*Reinforcement at the top and bottom of openings, where used in determining the maximum spacing specified in Item 3 above, shall be continuous in the wall.*~~

1908A.1.14 *(Relocated from 1915A.2.2.2, 2001 CBC)* ***Modify ACI 318 Section 15.2.2 by adding the following:***

External forces and moments are those resulting from the load combinations of Section ~~1612A.3~~ 1605A.3

~~**1908.1.15 - ACI 318, Section 22.10.** - Delete ACI 318, Section 22.10, and replace with the following:~~

~~*22.10 - Plain concrete in structures assigned to Seismic Design Category C, D, E or F.*~~

~~*22.10.1 - Structures assigned to Seismic Design Category C, D, E or F shall not have elements of structural plain concrete, except as follows:*~~

~~*(a) Structural plain concrete basement, foundation or other walls below the base are permitted in detached one- and two-family dwellings three stories or less in height constructed with stud-bearing walls. In dwellings assigned to Seismic Design Category D or E, the height of the wall shall not exceed 8 feet (2438 mm), the thickness shall not be less than 71/2 inches (190 mm), and the wall shall retain no more than 4 feet (1219 mm) of unbalanced fill. Walls shall have reinforcement in accordance with 22.6.6.5.*~~

~~*(b) Isolated footings of plain concrete supporting pedestals or columns are permitted, provided the projection of the footing beyond the face of the supported member does not exceed the footing thickness.*~~

~~*Exception: In detached one- and two-family dwellings three stories or less in height, the projection of the footing beyond the face of the supported member is permitted to exceed the footing thickness.*~~

~~*(c) Plain concrete footings supporting walls are permitted, provided the footings have at least two continuous longitudinal reinforcing bars. Bars shall not be smaller than No. 4 and shall have a total area of not less than 0.002 times the gross cross-sectional area of the footing. For footings that exceed 8 inches (203 mm) in thickness, a minimum of one bar shall be provided at the top and bottom of the footing. Continuity of reinforcement shall be provided at corners and intersections.*~~

~~***Exceptions:***~~

~~*1. In detached one- and two-family dwellings three stories or less in height and constructed with stud-bearing walls, plain concrete footings without longitudinal reinforcement supporting walls are permitted.*~~

~~*2. For foundation systems consisting of a plain concrete footing and a plain concrete stemwall, a minimum of one bar shall be provided at the top of the stemwall and at the bottom of the footing.*~~

~~*3. Where a slab on ground is cast monolithically with the footing, one No. 5 bar is permitted to be located at either the top of the slab or bottom of the footing.*~~

1908A.1.15 *(Relocated from 1915A.8.3.2, 2001 CBC)* ***Replace ACI 318 Section 15.8.3.2 as follows:***

15.8.3.2 - Connection between pre-cast walls and supporting members shall meet the requirements of ACI 318 Sections 16.5.1.3(b) & (c) but not less than required by Section ~~1611A~~ 1604A.

EXCEPTION: *In tilt-up construction, this connection may be to an adjacent floor slab. In no case shall the connection provided be less than that required by Section ~~1611A~~ 1604A.*

1908A.1.16 *(Relocated from 1916A.3.3, 2001 CBC)* ***Add Section 16.3.3 to ACI 318 as follows:***

16.3.3 - Nonbearing, nonshear panels such as nonstructural architectural cladding panels or column covers are not required to meet the provisions of Section ~~1916A.11~~ 1908A.1.17.

1908A.1.17 *(Relocated from 1916A.11, 2001 CBC)* ***Add Section 16.11 to ACI 318 as follows:***

16.11 ***- Reinforcement.*** *Perimeters of precast walls shall be reinforced continuously with a minimum of one No. 5 bar extending the full height and width of the wall panel. Bars shall be continuous around corners. Where wall panels do not abut columns or other wall panels, perimeter bars shall be retained by hooked wall bars. Edges of openings in precast walls shall be reinforced with a minimum of one No. 5 bar continuous past corners sufficient to develop the bar.*

A continuous tie or bond beam shall be provided at the roof line either as a part of the roof structure or part of the wall panels as described in the next paragraph below. This tie may be designed as the edge member of the roof diaphragm but, in any case, shall not be less than equivalent to two No. 6 bars continuous. A continuous tie equivalent to two No. 5 bars minimum shall also be provided either in the footing or with an enlarged section of the floor slab.

Wall panels of shear wall buildings shall be connected to columns or to each other in such a manner as to develop at least 75 percent of the horizontal wall steel. Half of this continuous horizontal reinforcing may be concentrated in bond or tie beams at the top and bottom of the walls and at points of intermediate lateral support. If possible, cast in-place joints with reinforcing bars extending from the panels into the joint a sufficient distance to meet the splice requirements of ~~Section 1912A.15~~ ACI 318 Section 12.15 for Class A shall be used. The reinforcing bars or welded tie details shall not be spaced over eight times the wall thickness neither vertically nor fewer than four used in the wall panel height. Where wall panels are designed for their respective overturning forces, the panel connections need not comply with the requirements of this paragraph.

Where splicing of reinforcement must be made at points of maximum stress or at closer spacing than permitted by ~~Section 1907A.6~~ ACI 318 Section 7.6, welding may be used when the entire procedure is suitable for the particular quality of steel used and the ambient conditions. Unless the welds develop 125 percent of the specified yield strength of the steel used, reinforcement in the form of continuous bars or fully anchored dowels shall be added to provide 25 percent excess steel area and the welds shall develop not less than the specified yield strength of the steel.

Where reinforcing bars are used to transfer shear across a joint the shear value for bolts set forth in Table ~~19A-D~~ 1912A.2 may be used.

Wall panels shall be positively connected to all floors and roofs as specified in CBC Sections ~~1605A,1611A and 1633A.2.4.2~~ 1604A, 1607A.13 and ASCE 7 Section 13.5. They shall be connected to the foundations when not anchored to the floor slab or otherwise properly anchored.

See ~~Sections 1910A.10, 1910A.11, 1910A.12 and 1910A.13~~ ACI 318 Sections 10.10, 10.11, 10.12 and 10.13 for design of compression forces in the precast walls.

1908A.1.18 *(Relocated from 1916A.12, 2001 CBC)* ***Add Section 16.12 to ACI 318 as follows:***

16.12 ***- On-site Cast Precast Wall Panels.***

16.12.1 - The provisions of ~~Sections 1916A.1, 1916A.2, 1916A.3, 1916A.4, 1916A.5, 1916A.6 and 1916A.11~~ ACI 318 Sections 16.1, 16.2, 16.3, 16.4, 16.5, 16.6 and 16.11 shall apply to precast wall panels cast on site.

16.12.2 - Precast bearing and nonbearing walls shall be designed in accordance with the provisions of ~~Section 1914A~~ ACI 318 Chapter 14. Panel concrete shall have attained the specified compressive strength (f'_c) before erection unless calculations provided by the structural engineer or architect demonstrate adequate serviceability during handling and erection for concrete panels of lesser strength.

16.12.3 - In lieu of unsupported height limitations, the panel may be supported laterally by vertical elements provided the panel thickness is not less than 1 / 36 the distance between the panel edges and the stiffness of the vertical elements exceeds that of the tributary area of the wall panels. See ~~1633A.2.4.2~~ ~~Section~~ ASCE 7 Section 13.5 for exterior elements.

16.12.4 -All embedded items shall be securely anchored in place prior to placing the concrete.

16.12.5 - Panels shall be allowed as much time as possible in the erect position before making longitudinal connections with an elapsed time of 28 days minimum between casting and connecting the panels.

16.12.6 - All details of reinforcement, connections, bearing seats, inserts, anchors, concrete cover, openings, fabrication and erection tolerances shall be shown on contract drawings.

1908A.1.19 Modify ACI 318 Section 17.5.1 by adding Sections 17.5.1.1 and 17.5.1.2 as follows:

17.5.1.1 - (Relocated from 1917A.5.1.1, 2001 CBC) Full transfer of horizontal shear forces may be assumed when all of the following are satisfied:

1. Contact surfaces are clean, free of laitance, and intentionally roughened to a full amplitude of approximately 1/4 inch (6.4 mm),

2. Minimum ties are provided in accordance with ACI 318 Section 17.6,

3. Web members are designed to resist total vertical shear, and

4. All shear reinforcement is fully anchored into all interconnected elements.

17.5.1.2 - (Relocated from 1917A.5.1.2, 2001 CBC) If all requirements of ACI 318 Section 17.5.1.1 are not satisfied, horizontal shear shall be investigated in accordance with ACI 318 Section 17.5.3 or 17.5.4.

1908A.1.20 *(Relocated from 1918A.2.3.2, 2001 CBC)* ***Modify ACI 318 Section 18.2.3 by adding the following:***

For prestressed concrete members with recessed or dapped ends, an analysis of the connections shall be made in accordance with procedures given in Part 6 of the PCI Design Handbook, ~~5~~th 6TH Edition.

1908A.1.21 *(Relocated from 1918A.2.4.2, 2001 CBC)* ***Modify ACI 318 Section 18.2.4 by adding the following:***

Where prestressed concrete elements are restrained from movement, an analysis of the stresses in the prestressed elements and loads in the adjoining structural system induced by the above-described effects shall be made in accordance with Part 3 of the PCI Design Handbook, ~~5~~th 6th Edition.

1908A.1.22 *(Relocated from 1918A.2.7, 2001 CBC)* ***Add Section 18.2.7 to ACI 318 as follows:***

*18.2.7 - **Span to Depth Ratio.** Span to depth ratios for prestressed concrete members shall not exceed the following, except when calculations of deflections prove that greater values may be used without adverse effects:*

Beams ……30
One-way Slabs ……..40
Two-way Floor Slabs…….. 40
Two-way Roof Slabs ……...44
Flat Slabs……See CBC Section ~~1918A.21~~ 1908A.1.28

These ratios should be decreased for special conditions such as heavy loads and simple spans.

Maximum deflection criteria shall be in accordance with ~~Section~~ ~~1909A.5~~ ACI 318 Section 9.5

1908A.1.23 *(Relocated from 1918A.6.4, 2001 CBC)* ***Add Section 18.6.4 to ACI 318 as follows:***

*18.6.4 - **Presumptive Loss of Prestress.** In lieu of an analysis to determine the loss of prestress from the above sources the loss may be assumed to be 35,000 psi (241 MPa) for pretensioned prestressed members. For posttensioned prestressed members the loss due to elastic shortening of concrete, creep of concrete, shrinkage of concrete, and relaxation of steel stress may be assumed to be 25,000 psi (172 MPa).*

1908A.1.24 *(Relocated from 1918A.9.2.2, 2001 CBC)* ***Modify ACI 318 Section 18.9.2.2 by adding the following:***

One-way, unbonded, posttensioned slabs and beams shall be designed to carry the dead load of the slab or beam plus 25 percent of the unreduced superimposed live load by some method other than the primary unbonded posttensioned reinforcement. Design shall be based on the strength method of design with a load factor and capacity reduction factor of one. All reinforcement other than the primary unbonded reinforcement provided to meet other requirements of this section may be used in the design.

1908A.1.25 *(Relocated from 1918A.9.2.3, 2001 CBC)* ***Modify ACI 318 Section 18.9.2 by adding Section 18.9.2.3 as follows:***

18.9.2.3 - Maximum spacing limitations of ~~Sections 1907A.6.1 and 1908A.10.5.2~~ ACI 318 Sections 7.6.1 and 8.10.5.2, for bonded reinforcement in slabs are not applicable to spacing of bonded reinforcement in members with unbonded tendons.

1908A.1.26 *(Relocated from 1918A.12.7, 2001 CBC)* ***Add Section 18.12.7 to ACI 318 as follows:***

*18.12.7 - **Openings in Flat Plates.** The requirements of ~~Section 1913A.4~~ ACI 318 Section 13.4 apply in principle to openings in posttensioned flat plates. Tendons should be continuous and splayed horizontally to get around smaller openings. If tendons are terminated at edges of larger openings, such as at stairwells, an analysis shall be made to ensure sufficient strength and proper behavior. Edges around openings may be reinforced in a manner similar to conventionally reinforced slabs, or, in the case of larger openings, supplementary, posttensioning tendons may be used to strengthen the edges.*

1908A.1.27 *(Relocated from 1918A.19.5, 2001 CBC)* ***Add Section 18.21.5 to ACI 318 as follows:***

*18.21.5 - **Prequalification of anchorages and coupler.** Posttensioned anchorages and couplers for unbonded tendons shall be prequalified for use in prestressed concrete. Data shall be submitted by the posttensioning materials fabricator from an approved independent testing agency to show compliance with the following dynamic test requirements:*

A dynamic test shall be performed on a representative specimen and the tendon shall withstand, without failure, 500,000 cycles from 60 percent to 66 percent of its minimum specified ultimate strength and 50 cycles from 40 percent to 80 percent of its minimum specified ultimate strength. The period of each cycle involves the change from the lower stress level to the upper

stress level and back to the lower. The specimen used for the second dynamic test need not be the same used for the first dynamic test. Systems utilizing multiple strands, wires or bars may be tested utilizing a test tendon of smaller capacity than the full-size tendon. The test tendon shall duplicate the behavior of the full-size tendon and generally shall not have less than 10 percent of the capacity of the full-size tendon.

The above test data must be on file at the enforcement agency for posttensioning systems to be used. General approval will be based on satisfactory performance. Tests shall be required for pre-stressing steel and anchorages.

The average bearing stress, P/A_b, on the concrete created by the anchorage plates shall not exceed the following:

At service load

$f_{cp} = 0.6\, f'_c \sqrt{(A'_b / A_b)}$

but not greater than f'_c

At transfer load

$f_{cp} = 0.8\, f'_{ci} \sqrt{(A'_b / A_b - 02)}$

but not greater than $1.25\, f'_{ci}$ where:

f_{cp} = permissible compressive concrete stress.

f'_c = compressive strength of concrete.

f'_{ci} = compressive strength of concrete at time of initial prestress.

A'_b = maximum area of the portion of the concrete anchorage surface that is geometrically similar to and concentric with the area of the anchorage.

A_b = bearing area of the anchorage.

P = prestress force in tendon.

1908A.1.28 *(Relocated from 1918A.21, 2001 CBC)* ***Add Section 18.23 to ACI 318 as follows:***

18.23 - ***Prestressed Flat Slab.***

18.23.1 - ***Span depth ratio.*** *The ratio of the span to depth of the slab continuous over at least three supports with cantilevers at the ends shall not be greater than 40 for floor slabs or 44 for roof slabs.*

18.23.2 - ***Distribution of tendons.*** *The use of banded tendons is acceptable. Maximum tendon spacing shall be six times the slab thickness, not to exceed 42 inches (1067 mm). A minimum prestress level of 125 psi (861 kPa) on the local slab section tributary to the tendon or tendon group is required. A minimum of two tendons in flat slabs shall be placed over columns in each direction. Tendons at slab edges shall be placed 6 inches (152 mm) clear of the slab edge. Tendons shall be firmly supported at intervals not exceeding 42 inches (1067 mm) to prevent displacement during concrete placement. Tendons shall not be bundled in groups greater than five monostrand tendons. At horizontal plane deviations grouped tendons at curved portions must be separated with 1-inch-minimum (25 mm) clear between each tendon.*

18.23.3 - ***Slab edge reinforcement.*** *The slab edges, including interior openings with anchorages, shall be reinforced with two No. 5 bars, one top and one bottom, minimum, with a No. 3 hairpin placed each side of each anchorage or tendon carrying an effective prestressing force of 50,000 pounds (223 kN) or less. These hairpins shall be increased to No. 4 hairpins if the effective force per anchorage or tendon is greater than 50,000 pounds (223 kN).*

~~1908.1.3~~ ***1908A.1.29*** **ACI 318, Section 21.1.** Modify existing definitions and add the following definitions to ACI 318, Section 21.1.

DESIGN DISPLACEMENT. Total lateral displacement expected for the design-basis earthquake, *as specified by Section 12.8.6 of ASCE 7.*

DETAILED PLAIN CONCRETE STRUCTURAL WALL. *A wall complying with the requirements of Chapter 22, including 22.6.7.*

ORDINARY PRECAST STRUCTURAL WALL. *A precast wall complying with the requirements of Chapters 1 through 18.*

ORDINARY REINFORCED CONCRETE STRUCTURAL WALL. A *cast-in-place* wall complying with the requirements of Chapters 1 through 18.

ORDINARY STRUCTURAL PLAIN CONCRETE WALL. A wall complying with the requirements of Chapter 22, *excluding 22.6.7.*

WALL PIER. *A wall segment with a horizontal length-to-thickness ratio of at least 2.5, but not exceeding 6, whose clear height is at least two times its horizontal length.*

~~1908A.1.4~~ ***1908A.1.30*** **ACI 318,** Section 21.2.1. Modify ACI 318 Sections 21.2.1.2~~, 1.2.1.3~~ and ~~21.2.1.4~~ *21.2.1.3*, to read as follows:

21.2.1.2 - ~~*For structures assigned to Seismic Design Category A or B,* provisions of Chapters 1 through 18 and 22 shall apply except as modified by the provisions of this chapter. Where the seismic design loads are computed using provisions for intermediate or special concrete systems, the requirements of Chapter 21 for intermediate or special systems, as applicable, shall be satisfied.~~ *(Relocated from 1921A.2.1.2, 2001 CBC)* *The provisions of ACI 318 Chapters 1 through 18 shall apply except as modified by the provisions of ACI 318 Chapter 21 and this Chapter.*

~~*21.2.1.3 - For structures assigned to Seismic Design Category C,* intermediate or special moment frames, intermediate precast structural walls *or ordinary or special reinforced concrete structural walls* shall be used to resist *seismic* forces induced by earthquake motions. Where the design seismic loads are computed using provisions for special concrete systems, the requirements of Chapter 21 for special systems, as applicable, shall be satisfied.~~

~~*21.2.1.4*~~ *21.2.1.3 - For structures assigned to Seismic Design Category D, E or F*, special moment frames, *special reinforced concrete structural walls*, diaphragms and trusses *and foundations* complying with 21.2 through 21.10 *or intermediate precast structural walls complying with* 21.13 shall be used to resist forces induced by earthquake motions. Members not proportioned to resist earthquake forces shall comply with 21.11.

~~1908A.1.5~~ ***1908A.1.31*** **ACI 318, Section 21.2.5.** Modify ACI 318, Section 21.2.5, by renumbering as Section 21.2.5.1 and adding new Section 21.2.5.2 to read as follows:

21.2.5 - Reinforcement in members resisting earthquake-induced forces.

21.2.5.1 - Except as permitted in 21.2.5.2, reinforcement resisting earthquake-induced flexural and axial forces in frame members and in structural wall boundary elements shall comply with ASTM A 706. ASTM 615, Grades 40 and 60 reinforcement, shall be permitted in these members if (a) the actual yield strength based on mill tests does not exceed the specified yield, f_y, strength by more than 18,000 psi (124 MPa) [retests shall not exceed this value by more than an additional 3,000 psi (21 MPa)], and (b) the ratio of the actual tensile strength to the actual yield strength is not less than 1.25.

For computing shear strength, the value of f_{yt} for transverse reinforcement, including spiral reinforcement, shall not exceed 60,000 psi (414 MPa).

21.2.5.2 - Prestressing steel shall be permitted in flexural members of frames, provided the average prestress, f_{pc}, calculated for an area equal to the member's shortest cross-sectional dimension multiplied

by the perpendicular dimension shall be the lesser of 700 psi (4.83 MPa) or $f'_c/6$ at locations of nonlinear action where prestressing steel is used in members of frames.

~~1908.1.6~~ ***1908A.1.32*** **ACI 318, Section 21.2.** Modify ACI 318, Section 21.2, by adding new Section 21.2.9 to read as follows:

21.2.9 - Anchorages for unbonded post-tensioning tendons resisting earthquake induced forces in structures assigned to Seismic Design Category ~~C,~~ D, E or F shall withstand, without failure, 50 cycles of loading ranging between 40 and 85 percent of the specified tensile strength of the prestressing steel.

~~1908.1.7~~ ***1908A.1.33*** **ACI 318, Section 21.3.** Modify ACI 318, Section 21.3, by adding new Section 21.3.2.5 to read as follows:

21.3.2.5 - Unless the special moment frame is qualified for use through structural testing as required by 21.6.3, for flexural members prestressing steel shall not provide more than one-quarter of the strength for either positive or negative moment at the critical section in a plastic hinge location and shall be anchored at or beyond the exterior face of a joint.

(Relocated from 1921A.2.5.5, 2001 CBC) Shear strength provided by prestressing tendons shall not be considered in design.

1908A.1.34 *(Relocated from 1921A.4.4.1 Item #6, 2001 CBC)* ***Modify ACI 318 section 21.4.4.1 as follows:***

Where the calculated point of contraflexure is not within the middle half of the member clear height, provide transverse reinforcement as specified in ACI 318 Sections 21.4.4.1, Items (a) through (c), over the full height of the member.

1908A.1.35 *(Relocated from 1921A.4.4.7, 2001 CBC)* ***Modify ACI 318 by adding Section 21.4.4.7 as follows:***

21.4.4.7- At any section where the design strength, φP_n, of the column is less than the sum of the shears V_e computed in accordance with ACI 318 Sections 21.3.4.1 and 21.4.5.1 for all the beams framing into the column above the level under consideration, transverse reinforcement as specified in ACI 318 Sections 21.4.4.1 through 21.4.4.3 shall be provided. For beams framing into opposite sides of the column, the moment components may be assumed to be of opposite sign. For the determination of the design strength, φP_n, of the column, these moments may be assumed to result from the deformation of the frame in any one principal axis.

1908A.1.36 *(Relocated from 1921A.5.4.5, 2001 CBC)* ***Modify ACI 318 by adding Section 21.5.4.5 as follows:***

21.5.4.5 - Splices shall be based on the development length, ℓ_d, for a straight bar as determined by ~~Sections 1921A.5.4.1 and 1921A.5.4.2~~ ACI 318 Sections 21.5.4.1 and 21.5.4.2 and modified by the factors in ~~Section 1912A~~ ACI 318 Chapter 12.

1908A.1.37 *(Relocated from 1921A.6.6.4, 2001 CBC)* ***Modify ACI 318, Section 21.7.2.2 by adding the following:***

Where boundary members are not required by ~~Section 1921A.6.6.4~~ ACI 318 Section 21.7.6, minimum reinforcement parallel to the edges of all ~~diaphragms~~ structural walls and the boundaries of all openings shall consist of twice the cross-sectional area of the minimum shear reinforcement required per lineal foot of wall. Horizontal extent of boundary element shall be per ACI 318 Section 21.7.6.4 (a) & (b).

1908A.1.38 *(Relocated from 1921A.6.6.3.2, 2001 CBC)* ***Modify ACI 318 by adding Section 21.7.4.6 as follows:***

21.7.4.6 - Walls and portions of walls with $P_u > 0.35P_o$ shall not be considered to contribute to the calculated strength of the structure for resisting earthquake-induced forces. Such walls shall conform to the requirements of ~~Section 1631.2, Item 4~~ ACI 318 Section 21.11.

~~1908.1.8~~ ***1908A.1.39*** **ACI 318, Section 21.7.** Modify ACI 318, Section 21.7, by adding new Section 21.7.10 to read as follows:

21.7.10 - Wall piers and wall segments.

21.7.10.1 - Wall piers not designed as a part of a special moment frame shall have transverse reinforcement designed to satisfy the requirements in 21.7.10.2.

Exceptions:

1. *Wall piers that satisfy 21.11.*

2. *Wall piers along a wall line within a story where other shear wall segments provide lateral support to the wall piers and such segments have a total stiffness of at least six times the sum of the stiffness of all the wall piers.*

21.7.10.2 - Transverse reinforcement with seismic hooks at both ends shall be designed to resist the shear forces determined from 21.4.5.1. Spacing of transverse reinforcement shall not exceed 6 inches (152 mm). Transverse reinforcement shall be extended beyond the pier clear height for at least 12 inches (305 mm).

21.7.10.3 - Wall segments with a horizontal length-to-thickness ratio less than 2.5 shall be designed as columns.

~~1908.1. 9~~ ***1908A.1.40*** **ACI 318, Section 21.8.** Modify Section 21.8.1 to read as follows:

21.8.1 - Special structural walls constructed using precast concrete shall satisfy all the requirements of 21.7 for cast-in-place special structural walls in addition to Section 21.13.2 *through* ~~*21.13.4*~~ *21.13.6.*

1908A.1.41 *(Relocated from 1921A.6.12, Item #3 2001 CBC)* ***Modify ACI 318 section 21.9.4 by adding the following****:*

Collector and boundary elements in topping slabs placed over precast floor and roof elements shall not be less than 3 inches (76 mm) or 6 d_b thick, where d_b is the diameter of the largest reinforcement in the topping slab.

1908A.1.42 *(Relocated from 1921A.6.2.2, 2001 CBC)* ***Modify ACI 318 by adding Section 21.9.5.6 as follows:***

21.9.5.6 - Where boundary members are not required by ~~Section 1921A.6.2.3~~ ACI 318 Section 21.9.5.3, minimum reinforcement parallel to the edges of all diaphragms and the boundaries of all openings shall consist of twice the cross-sectional area of the minimum shear reinforcement required per linear foot of ~~wall~~ diaphragm.

~~1908.1.10~~ ***1908A.1. 43*** **ACI 318, Section 21.10.1.1.** Modify ACI 318, Section 21.10.1.1, to read as follows:

21.10.1.1 - Foundations resisting earthquake-induced forces or transferring earthquake-induced forces between a structure and the ground shall comply with the requirements of Section 21.10 and other applicable provisions of ACI 318 *unless modified by Chapter 18A of the ~~International~~ California Building Code*.

~~1908.1.11~~ ***1908A.1.44*** **ACI 318, Section 21.11.** Modify ACI 318, Section 21.11.2.2 to read as follows:

21.11.2.2 - Members with factored gravity axial forces exceeding $(A_g f'_c/10)$ shall satisfy 21.4.3, 21.4.4.1(c), 21.4.4.3 and 21.4.5. The maximum longitudinal spacing of ties shall be s_o for the full column height. Spacing, s_o, shall not exceed the smaller of six diameters of the smallest longitudinal bar enclosed and 6 inches (152 mm). *Lap splices of longitudinal reinforcement in such members need not satisfy 21.4.3.2 in structures where the seismic-force-resisting system does not include special moment frames.*

~~1908.1.12~~ ***1908A.1. 45*** **ACI 318, Section 21.12.5.** Modify ACI 318, Section 21.12.5, by adding new Section 21.12.5.6 to read as follows:

21.12.5.6 - Columns supporting reactions from discontinuous stiff members, such as walls, shall be designed for the special load combinations in Section 1605A.4 of the ~~International~~ California Building Code and shall be provided with transverse reinforcement at the spacing, s_o, as defined in 21.12.5.2 over their full height beneath the level at which the discontinuity occurs. This transverse reinforcement shall be extended above and below the column as required in 21.4.4.5.

~~1908.1.13~~ ***1908A.1.46*** **ACI 318, Section 21.13.** Modify ACI 318, Section 21.13, by renumbering Section 21.13.3 to become 21.13.4 and adding new Sections 21.13.3, 21.13.5 and 21.13.6 to read as follows:

21.13.3 - Except for Type 2 mechanical splices, connection elements that are designed to yield shall be capable of maintaining 80 percent of their design strength at the deformation induced by the design displacement.

21.13.4 - Elements of the connection that are not designed to yield shall develop at least $1.5S_y$.

21.13.5 - Wall piers not designed as part of a moment frame shall have transverse reinforcement designed to resist the shear forces determined from 21.12.3. Spacing of transverse reinforcement shall not exceed 8 inches (203 mm). Transverse reinforcement shall be extended beyond the pier clear height for at least 12 inches (305 mm).

Exceptions:

1. *Wall piers that satisfy 21.11.*

2. *Wall piers along a wall line within a story where other shear wall segments provide lateral support to the wall piers and such segments have a total stiffness of at least six times the sum of the stiffnesses of all the wall piers.*

21.13.6 - Wall segments with a horizontal length-to-thickness ratio less than 2.5 shall be designed as columns.

~~1908.1.16~~ ***1908A.1.47*** **ACI 318, Section D.3.3.** Modify ACI 318, Sections D.3.3.2 through D.3.3.5, to read as follows:

D.3.3.2 -*In structures assigned to Seismic Design Category ~~C,~~ D, E or F,* post-installed anchors for use under D.2.3 shall have passed the Simulated Seismic Tests of ACI 355.2.

D.3.3.3 -*In structures assigned to Seismic Design Category ~~C,~~ D, E or F,* the design strength of anchors shall be taken as $0.75\varphi N_n$ and $0.75\varphi V_n$, where φ is given in D.4.4 or D.4.5, and N_n and V_n are determined in accordance with D.4.1.

D.3.3.4 -*In structures assigned to Seismic Design Category ~~C,~~ D, E or F,* anchors shall be designed to be governed by tensile or shear strength of a ductile steel element, unless D.3.3.5 is satisfied.

Exception: Anchors in concrete designed to support non-structural components in accordance with ASCE 7 Section 13.4.2 need not satisfy Section D.3.3.4.

D.3.3.5 - Instead of D.3.3.4, the attachment that the anchor is connecting to the structure shall be designed so that the attachment will undergo ductile yielding at a load level corresponding to anchor forces no greater than the design strength of anchors specified in D.3.3.3*, or the minimum design strength of the anchors shall be at least 2.5 times the factored forces transmitted by the attachment*.

Exception: Anchors in concrete designed to support non-structural components in accordance with ASCE 7 Section 13.4.2 need not satisfy Section D.3.3.5.

SECTION 1909A - STRUCTURAL PLAIN CONCRETE

1909A.1 Scope. *(Relocated from 1922A.1, 2001 CBC) Plain concrete shall not be used other than as fill. The minimum specified compression strength of concrete used as fill shall be 1,500 psi (10.3 MPa) at 28 days.* ~~The design and construction of structural plain concrete, both cast-in-place and precast, shall comply with the minimum requirements of Section 1909A and ACI 318, Chapter 22, as modified in Section 1908.~~

~~**1909.1.1 Special structures.** For special structures, such as arches, underground utility structures, gravity walls and shielding walls, the provisions of this section shall govern where applicable.~~

~~**1909.2 Limitations.** The use of structural plain concrete shall be limited to:~~

~~1. Members that are continuously supported by soil, such as walls and footings, or by other structural members capable of providing continuous vertical support.~~

~~2. Members for which arch action provides compression under all conditions of loading.~~

~~3. Walls and pedestals.~~

~~The use of structural plain concrete columns and structural plain concrete footings on piles is not permitted. See Section 1908.1.15 for additional limitations on the use of structural plain concrete.~~

~~**1909.3 Joints.** Contraction or isolation joints shall be provided to divide structural plain concrete members into flexurally discontinuous elements in accordance with ACI 318, Section 22.3.~~

~~**1909.4 Design.** Structural plain concrete walls, footings and pedestals shall be designed for adequate strength in accordance with ACI 318, Sections 22.4 through 22.8.~~

~~**Exception:** For Group R-3 occupancies and buildings of other occupancies less than two stories in height of light-frame construction, the required edge thickness of ACI 318 is permitted to be reduced to 6 inches (152 mm), provided that the footing does not extend more than 4 inches (102 mm) on either side of the supported wall.~~

~~**1909.5 Precast members.** The design, fabrication, transportation and erection of precast, structural plain concrete elements shall be in accordance with ACI 318, Section 22.9.~~

~~**1909.6 Walls.** In addition to the requirements of this section, structural plain concrete walls shall comply with the applicable requirements of ACI 318, Chapter 22.~~

~~**1909.6.1 Basement walls.** The thickness of exterior basement walls and foundation walls shall be not less than 71/2 inches (191 mm). Structural plain concrete exterior basement walls shall be exempt from the requirements for special exposure conditions of Section 1904.2.2.~~

~~**1909.6.2 Other walls.** Except as provided for in Section 1909.6.1, the thickness of bearing walls shall be not less than 1/24 the unsupported height or length, whichever is shorter, but not less than 51/2 inches (140 mm).~~

~~**1909.6.3 Openings in walls.** Not less than two No. 5 bars shall be provided around window and door openings. Such bars shall extend at least 24 inches (610 mm) beyond the corners of openings.~~

SECTION 1910*A* - MINIMUM SLAB PROVISIONS

1910*A*.1 General. The thickness of concrete floor slabs supported directly on the ground shall not be less than $3^1/_2$ inches (89 mm). A 6-mil (0.006 inch; 0.15 mm) polyethylene vapor retarder with joints lapped not less than 6 inches (152 mm) shall be placed between the base course or subgrade and the concrete floor slab, or other approved equivalent methods or materials shall be used to retard vapor transmission through the floor slab.

Exception: A vapor retarder is not required:

1. For detached structures accessory to occupancies in Group R-3, such as garages, utility buildings or other unheated facilities.

2. For unheated storage rooms having an area of less than 70 square feet (6.5 m^2) and carports attached to occupancies in Group R-3.

3. For buildings of other occupancies where migration of moisture through the slab from below will not be detrimental to the intended occupancy of the building.

4. For driveways, walks, patios and other flatwork which will not be enclosed at a later date.

5. Where approved based on local site conditions.

SECTION 1911*A* ANCHORAGE TO CONCRETE— ALLOWABLE STRESS DESIGN

1911*A*.1 Scope. The provisions of this section shall govern the allowable stress design of headed bolts and headed stud anchors cast in normal-weight concrete for purposes of transmitting structural loads from one connected element to the other. These provisions do not apply to anchors installed in hardened concrete or where load combinations include earthquake loads or effects. The bearing area of headed anchors shall be not less than one and one-half times the shank area. Where strength design is used, or where load combinations include earthquake loads or effects, the design strength of anchors shall be determined in accordance with Section 1912*A*. Bolts shall conform to ASTM A 307 or an approved equivalent.

1911*A*.2 Allowable service load. The allowable service load for headed anchors in shear or tension shall be as indicated in Table 1911*A*.2. Where anchors are subject to combined shear and tension, the following relationship shall be satisfied:

$(P_s / P_t)^{5/3} + (V_s / V_t)^{5/3} \leq 1$ **(Equation 19*A*-1)**

where:

P_s = Applied tension service load, pounds (N).

P_t = Allowable tension service load from Table 1911*A*.2, pounds (N).

V_s = Applied shear service load, pounds (N).

V_t = Allowable shear service load from Table 1911*A*.2, pounds (N).

TABLE 1911*A*.2 - ALLOWABLE SERVICE LOAD ON EMBEDDED BOLTS (pounds)

BOLT DIAMETER (inches)	MINIMUM EMBEDMENT (inches)	EDGE DISTANCE (inches)	SPACING (inches)	MINIMUM CONCRETE STRENGTH (psi)					
				f'_c= 2,500		f'_c= 3,000		f'_c= 4,000	
				Tension	Shear	Tension	Shear	Tension	Shear
1/4	2 1/2	1 1/2	3	200	500	200	500	200	500
3/8	3	2 1/4	4 1/2	500	1,100	500	1,100	500	1,100
1/2	4 4	3 5	6 5	950 1,450	1,250 1,600	950 1,500	1,250 1,650	950 1,550	1,250 1,750
5/8	4 1/2 4 1/2	3 3/4 6 1/4	7 1/2 7 1/2	1,500 2,125	2,750 2,950	1,500 2,200	2,750 3,000	1,500 2,400	2,750 3,050
3/4	5 5	4 1/2 7 1/2	9 9	2,250 2,825	3,250 4,275	2,250 2,950	3,560 4,300	2,250 3,200	3,560 4,400
7/8	6	5 1/4	10 1/2	2,550	3,700	2,550	4,050	2,550	4,050
1	7	6	12	3,050	4,125	3,250	4,500	3,650	5,300
1 1/8	8	6 3/4	13 1/2	3,400	4,750	3,400	4,750	3,400	4,750
1 1/4	9	7 1/2	15	4,000	5,800	4,000	5,800	4,000	5,800

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 pound = 4.45 N.

1911*A*.3 Required edge distance and spacing. The allowable service loads in tension and shear specified in Table 1911*A*.2 are for the edge distance and spacing specified. The edge distance and spacing are permitted to be reduced to 50 percent of the values specified with an equal reduction in allowable service load. Where edge distance and spacing are reduced less than 50 percent, the allowable service load shall be determined by linear interpolation.

1911*A*.4 Increase in allowable load. Increase of the values in Table 1911*A*.2 by one-third is permitted where the provisions of Section 1605*A*.3.2 permit an increase in allowable stress for wind loading.

1911*A*.5 Increase for special inspection. Where special inspection is provided for the installation of anchors, a 100-percent increase in the allowable tension values of Table 1911*A*.2 is permitted. No increase in shear value is permitted.

SECTION 1912*A* - ANCHORAGE TO CONCRETE— STRENGTH DESIGN

1912*A*.1 Scope. The provisions of this section shall govern the strength design of anchors installed in concrete for purposes of transmitting structural loads from one connected element to the other. Headed bolts, headed studs and hooked (J- or L-) bolts cast in concrete and expansion anchors and undercut anchors installed in hardened concrete shall be designed in accordance with Appendix D of ACI 318 as modified by Section ~~1908.1.16~~ *1908A.1.47*, provided they are within the scope of Appendix D.

> **Exception:** Where the basic concrete breakout strength in tension of a single anchor, N_b, is determined in accordance with Equation (D-7), the concrete breakout strength requirements of Section D.4.2.2 shall be considered satisfied by the design procedures of Sections D.5.2 and D.6.2 for anchors exceeding 2 inches (51 mm) in diameter or 25 inches (635 mm) tensile embedment depth.

The strength design of anchors that are not within the scope of Appendix D of ACI 318, and as amended above, shall be in accordance with an approved procedure.

SECTION 1913*A* - SHOTCRETE

1913*A*.1 General. *(Relocated from 1924A.1, 2001 CBC)* Shotcrete is mortar or concrete that is pneumatically projected at high velocity onto a surface. ~~*Included are such terms commonly known as gunite and guncrete.*~~ Except as specified in this section, shotcrete shall conform to the requirements of this chapter for ~~plain or~~ reinforced concrete~~.~~ *and the provisions of ACI 506.* ~~*Working stresses for the design of reinforced shotcrete shall be based on the specified compressive strength of the shotcrete to be used in the structure.*~~ *The specified compressive strength of shotcrete shall not be less than 3,000 psi (20.69 MPa).*

Concrete or masonry to receive shotcrete shall have the entire surface thoroughly cleaned and roughened by sand blasting, and just prior to receiving shotcrete, shall be thoroughly cleaned of all debris, dirt and dust. Concrete and masonry shall be wetted before shotcrete is deposited, but not so wet as to overcome suction. Sand for sand blasting shall be clean, sharp and uniform in size, with no particles that will pass a 50-mesh screen.

1913*A*.2 Proportions and materials. Shotcrete proportions shall be selected that allow suitable placement procedures using the delivery equipment selected and shall result in finished in-place hardened shotcrete meeting the strength requirements of this code.

1913*A*.3 Aggregate. Coarse aggregate, if used, shall not exceed $^3/_4$ inch (19.1 mm).

1913*A*.4 Reinforcement. Reinforcement used in shotcrete construction shall comply with the provisions of Sections 1913*A*.4.1 through 1913*A*.4.4.

> **1913*A*.4.1 Size.** The maximum size of reinforcement shall be No. 5 bars unless it is demonstrated by preconstruction tests that adequate encasement of larger bars will be achieved.
>
> **1913*A*.4.2 Clearance.** When No. 5 or smaller bars are used, there shall be a minimum clearance between parallel reinforcement bars of $2^1/_2$ inches (64 mm). When bars larger than No. 5 are permitted, there shall be a minimum clearance between parallel bars equal to six diameters of the bars used. When two curtains of steel are provided, the curtain nearer the nozzle shall have a minimum spacing equal to 12 bar diameters and the remaining curtain shall have a minimum spacing of six bar diameters.
>
> > **Exception:** Subject to the approval of the building official, required clearances shall be reduced where it is demonstrated by preconstruction tests that adequate encasement of the bars used in the design will be achieved.
>
> **1913*A*.4.3 Splices.** Lap splices of reinforcing bars shall utilize the noncontact lap splice method with a minimum clearance of 2 inches (51 mm) between bars. The use of contact lap splices necessary for support of the reinforcing

is permitted when approved by the building official, based on satisfactory preconstruction tests that show that adequate encasement of the bars will be achieved, and provided that the splice is oriented so that a plane through the center of the spliced bars is perpendicular to the surface of the shotcrete.

1913A.4.4 Spirally tied columns. Shotcrete shall not be applied to spirally tied columns.

1913A.5 Preconstruction tests. When required by the building official, a test panel shall be shot, cured, cored or sawn, examined and tested prior to commencement of the project. The sample panel shall be representative of the project and simulate job conditions as closely as possible. The panel thickness and reinforcing shall reproduce the thickest and most congested area specified in the structural design. It shall be shot at the same angle, using the same nozzleman and with the same concrete mix design that will be used on the project. The equipment used in preconstruction testing shall be the same equipment used in the work requiring such testing, unless substitute equipment is approved by the building official.

1913A.6 Rebound. Any rebound or accumulated loose aggregate shall be removed from the surfaces to be covered prior to placing the initial or any succeeding layers of shotcrete. Rebound shall not be used as aggregate.

1913A.7 Joints. Except where permitted herein, unfinished work shall not be allowed to stand for more than 30 minutes unless edges are sloped to a thin edge. For structural elements that will be under compression and for construction joints shown on the approved construction documents, square joints are permitted. Before placing additional material adjacent to previously applied work, sloping and square edges shall be cleaned and wetted.

(Relocated from 1924A.7, 2001 CBC) The film of laitance which forms on the surface of the shotcrete shall be removed within approximately two hours after application by brushing with a stiff broom. If this film is not removed within two hours, it shall be removed by thorough wire brushing or sand blasting. Construction joints over eight hours old shall be thoroughly cleaned with air and water prior to receiving shotcrete.

1913A.8 Damage. In-place shotcrete that exhibits sags, sloughs, segregation, honeycombing, sand pockets or other obvious defects shall be removed and replaced. Shotcrete above sags and sloughs shall be removed and replaced while still plastic.

1913A.9 Curing. During the curing periods specified herein, shotcrete shall be maintained above 40°F (4°C) and in moist condition.

1913A.9.1 Initial curing. Shotcrete shall be kept continuously moist for 24 hours after shotcreting is complete or shall be sealed with an approved curing compound.

1913A.9.2 Final curing. Final curing shall continue for seven days after shotcreting, or for three days if high-early-strength cement is used, or until the specified strength is obtained. Final curing shall consist of the initial curing process or the shotcrete shall be covered with an approved moisture-retaining cover.

1913A.9.3 Natural curing. Natural curing shall not be used in lieu of that specified in this section unless the relative humidity remains at or above 85 percent, and is authorized by the registered design professional and approved by the building official.

1913A.10 Strength tests. Strength tests for shotcrete shall be made *(Relocated from 1924A.10, 2001 CBC) in accordance with ASTM standards* by an approved agency on specimens that are representative of the work and which have been water soaked for at least 24 hours prior to testing. When the maximum-size aggregate is larger than $^3/_8$ inch (9.5 mm), specimens shall consist of not less than three 3-inch-diameter (76 mm) cores or 3-inch (76 mm) cubes. When the maximum-size aggregate is $^3/_8$ inch (9.5 mm) or smaller, specimens shall consist of not less than 2-inch-diameter (51 mm) cores or 2-inch (51 mm) cubes.

1913A.10.1 Sampling. Specimens shall be taken from the in-place work or from test panels, and shall be taken at least once each shift, but not less than one for each 50 cubic yards (38.2 m^3) of shotcrete.

1913A.10.2 Panel criteria. When the maximum-size aggregate is larger than $^3/_8$ inch (9.5 mm), the test panels shall have minimum dimensions of 18 inches by 18 inches (457 mm by 457 mm). When the maximum size aggregate is $^3/_8$ inch (9.5 mm) or smaller, the test panels shall have minimum dimensions of 12 inches by 12 inches (305 mm by 305 mm). Panels shall be shot in the same position as the work, during the course of the work and by the nozzlemen doing the work. The conditions under which the panels are cured shall be the same as the work. *(Relocated from 1924A.10, 2001 CBC) Approval from the enforcement agency must be obtained prior to performing the test panel method.*

1913*A*.10.3 Acceptance criteria. The average compressive strength of three cores from the in-place work or a single test panel shall equal or exceed $0.85f'_c$ with no single core less than $0.75f'_c$. The average compressive strength of three cubes taken from the in-place work or a single test panel shall equal or exceed f'_c with no individual cube less than $0.88f'_c$. To check accuracy, locations represented by erratic core or cube strengths shall be retested.

1913A.11 *(Relocated from 1924A.12, 2001 CBC)* ***Equipment.*** *The equipment used in preconstruction testing shall be the same equipment used in the work requiring such testing, unless substitute equipment is approved by the enforcement agency.*

1913A.12 *(Relocated from 1924A.13, 2001 CBC)* ***Forms and Ground Wires for Shotcrete.*** *Forms for shotcrete shall be substantial and rigid. Forms shall be built and placed so as to permit the escape of air and rebound.*

Adequate ground wires, which are to be used as screeds, shall be placed to establish the thickness, surface planes and form of the shotcrete work. All surfaces shall be rodded to these wires.

1913A.13 *(Relocated from 1924A.14, 2001 CBC)* ***Placing.*** *Shotcrete shall be placed in accordance with ACI 506.*

SECTION 1914*A* - REINFORCED GYPSUM CONCRETE

1914*A*.1 General. Reinforced gypsum concrete shall comply with the requirements of ASTM C 317 and ASTM C 956. *Reinforced gypsum concrete shall be considered as an alternative system.*

1914*A*.2 Minimum thickness. The minimum thickness of reinforced gypsum concrete shall be 2 inches (51 mm) except the minimum required thickness shall be reduced to $1^1/_2$ inches (38 mm), provided the following conditions are satisfied:

1. The overall thickness, including the formboard, is not less than 2 inches (51 mm).
2. The clear span of the gypsum concrete between supports does not exceed 33 inches (838 mm).
3. Diaphragm action is not required.
4. The design live load does not exceed 40 pounds per square foot (psf) (1915 Pa).

SECTION 1915*A* - CONCRETE-FILLED PIPE COLUMNS

1915*A*.1 General. Concrete-filled pipe columns shall be manufactured from standard, extra-strong or double-extra-strong steel pipe or tubing that is filled with concrete so placed and manipulated as to secure maximum density and to ensure complete filling of the pipe without voids.

1915*A*.2 Design. The safe supporting capacity of concrete-filled pipe columns shall be computed in accordance with the approved rules or as determined by a test.

1915*A*.3 Connections. Caps, base plates and connections shall be of approved types and shall be positively attached to the shell and anchored to the concrete core. Welding of brackets without mechanical anchorage shall be prohibited. Where the pipe is slotted to accommodate webs of brackets or other connections, the integrity of the shell shall be restored by welding to ensure hooping action of the composite section.

1915*A*.4 Reinforcement. To increase the safe load-supporting capacity of concrete-filled pipe columns, the steel reinforcement shall be in the form of rods, structural shapes or pipe embedded in the concrete core with sufficient clearance to ensure the composite action of the section, but not nearer than 1 inch (25 mm) to the exterior steel shell. Structural shapes used as reinforcement shall be milled to ensure bearing on cap and base plates.

1915*A*.5 Fire-resistance-rating protection. Pipe columns shall be of such size or so protected as to develop the required fire-resistance ratings specified in Table 601. Where an outer steel shell is used to enclose the fire-resistant

covering, the shell shall not be included in the calculations for strength of the column section. The minimum diameter of pipe columns shall be 4 inches (102 mm) except that in structures of Type V construction not exceeding three stories or 40 feet (12 192 mm) in height, pipe columns used in the basement and as secondary steel members shall have a minimum diameter of 3 inches (76 mm).

1915*A*.6 Approvals. Details of column connections and splices shall be shop fabricated by approved methods and shall be approved only after tests in accordance with the approved rules. Shop-fabricated concrete-filled pipe columns shall be inspected by the building official or by an approved representative of the manufacturer at the plant.

SECTION 1916A - CONCRETE TESTING

1916A.1 *(Relocated from 1929A.1, 2001 CBC)* ***Cementitious Material*** ~~*Test.*~~ *The concrete supplier shall furnish to the enforcement agency certification* ~~*from the cement manufacturer*~~ *that the cement proposed for use on the project has been manufactured and tested in compliance with the requirements of ASTM C 150 for portland cement and ASTM C 595 or ASTM C 1157 for blended hydraulic cement, whichever is applicable. When a mineral admixture or ground granulated blast-furnace slag is proposed for use, the concrete supplier shall furnish to the enforcement agency certification* ~~*from the manufacturer*~~ *that they have been manufactured and tested in compliance with ASTM C 618 or ASTM C 989, whichever is applicable.* ~~*An affidavit shall be provided by the concrete supplier which identifies the cementitious material used for the project by the manufacturer.s lot number, date of shipment from the manufacturer, date of receipt of cementitious material by the concrete supplier, place of storage and date of use of the cementitious material. If such information is not available, one grab sample of cementitious material used on the project shall be taken for each day.s pour and shall be tested as directed by the structural engineer, architect or enforcement agency. See Section 1929A.6 for waiver of tests.*~~ *The concrete producer shall provide copies of the cementitious material supplier's Certificate of Compliance that represents the materials used by date of shipment for concrete. Cementitious materials without Certification of Compliance shall not be used.*

1916A.2 *(Relocated from 1929A.2, 2001 CBC)* ***Tests of Reinforcing Bars****. Where samples are taken from bundles as delivered from the mill, with the bundles identified as to heat number and provided the mill analyses accompany the report, one tensile test and one bend test shall be made from a specimen from each 10 tons (9080 kg) or fraction thereof of each size of reinforcing steel.*

Where positive identification of the heat number cannot be made or where random samples are to be taken, one series of tests shall be made from each 2 1/2 tons (2270 kg) or fraction thereof of each size of reinforcing steel. See Section ~~*1929A.6*~~ *1916A.4 for waiver of tests.*

1916A.3 *(Relocated from 1929A.3, 2001 CBC)* ***Tests for Prestressing Steel and Anchorage****. All wires or bars of each size from each mill heat and all strands from each manufactured reel to be shipped to the site shall be assigned an individual lot number and shall be tagged in such a manner that each lot can be accurately identified at the jobsite. Each lot of tendon and anchorage assemblies and bar couplers to be installed shall be likewise identified.*

The following samples of materials and tendons selected by the engineer or the designated testing laboratory from the prestressing steel at the plant or jobsite shall be furnished by the contractor and tested by an approved independent testing agency:

1. *For wire, strand or bars, 7-foot-long (2134 mm) samples shall be taken of the coil of wire or strand reel or rods. A minimum of one random sample per 5,000 pounds (2270 kg) of each heat or lot used on the job shall be selected.*

2. *For prefabricated prestressing tendons other than bars, one completely fabricated tendon 10 feet (3048 mm) in length between grips with anchorage assembly at one end shall be furnished for each size and type of tendon and anchorage assembly.*

   Variations of the bearing plate size need not be considered.

   The anchorages of unbonded tendons shall develop at least 95 percent of the minimum specified ultimate strength of the pre-stressing steel. The total elongation of the tendon under ultimate load shall not be less than 2 percent measured in a minimum gage length of 10 feet (3048 mm).

   Anchorages of bonded tendons shall develop at least 90 percent of the minimum specified strength of the prestressing steel tested in an unbonded state. All couplings shall develop at least 95

percent of the minimum specified strength of the prestressing steel and shall not reduce the elongation at rupture below the requirements of the tendon itself.

3. *If the prestressing tendon is a bar, one 7-foot (2134 mm) length complete with one end anchorage shall be furnished and, in addition, if couplers are to be used with the bar, two 4-foot (1219 mm) lengths of bar fabricated to fit and equipped with one coupler shall be furnished.*

4. *Mill tests of materials used for end anchorages shall be furnished. In addition, at least one Brinnell hardness test shall be made of each thickness of bearing plate.*

1916A.4 *(Relocated from 1929A.6, 2001 CBC)* ***Waiver of Material Testing.*** *Tests of ~~cement and~~ reinforcing bars may be waived by the architect or structural engineer with the approval of the enforcement agency for one-story buildings where the specified compressive strength of the concrete f'_c, delivered to the jobsite is 3,500 psi (24.13 MPa) and where the f'_c used in design is 2,500 psi (17.24 MPa).*

1916A.5 *(Relocated from 1929A.8, 2001 CBC)* ***Composite Construction Cores****. Cores of the completed composite concrete construction shall be taken to demonstrate the shear strength along the contact surfaces. The cores shall be tested when the cast-in-place concrete is approximately 28 days old and shall be tested by a shear loading parallel to the joint between the precast concrete and the cast-in-place concrete. The minimum unit shear strength of the contact surface area of the core shall not be less than 100 psi (689 kPa).*

At least one core shall be taken from each building for each 5,000 square feet (465m2) of area of composite concrete construction and not less than three cores shall be taken from each project. The architect or structural engineer in responsible charge of the project or his or her representative shall designate the location for sampling.

1916A.6 *(Relocated from 1929A.11, 2001 CBC)* ***Tests of Shotcrete.*** *Testing of shotcrete shall follow the provisions of Section ~~1924A.10~~ 1913A and the general requirements of ~~Section 1905A.6~~ ACI 318 Section 5.6.*

1916.7 *(Relocated from 1929A.13, 2001 CBC)* ***Gypsum Field Tests.*** *Field tests shall be made during construction to verify gypsum strength ~~specified in Table 19A-E~~. One sample consisting of three specimens shall be made for each 5,000 square feet (465 m2) or fraction thereof of all gypsum poured, but not less than one sample shall be taken from each half day's pour.*

1916A.8 *(Relocated from 1923A.3.5, 2001 CBC)* ***Post-Installed Anchors in Concrete Tests.*** *When drilled-in expansion-type anchors or other post-installed anchors acceptable to enforcement agency are used in lieu of cast-in place bolts, the allowable shear and tension values and installation verification test loads shall be acceptable to the enforcement agency.*

When expansion-type anchors are listed for sill plate bolting applications, 10 percent of the anchors shall be tension tested.

When expansion-type anchors are used for other structural applications, all such expansion anchors shall be tension tested. Expansion-type anchors shall not be used as hold down bolts.

When expansion-type anchors are used for nonstructural applications such as equipment anchorage, 50 percent or alternate bolts in a group, including at least one-half the anchors in each group, shall be tension tested.

The tension testing of the expansion anchors shall be done in the presence of the special inspector and a report of the test results shall be submitted to the enforcement agency. If any anchors fail the tension-testing requirements, the additional testing requirements shall be acceptable to the enforcement agency. The above requirements shall also apply to other post-installed anchors acceptable to enforcement agency and bolts or anchors set in concrete with chemical if the long-term durability and stability of the chemical material and its resistance to loss of strength and chemical change at elevated temperatures are established to the satisfaction of the enforcement agency.

(Relocated from 1930A, 2001 CBC) ***SECTION 1917A - EXISTING CONCRETE STRUCTURES***

1917A.1. EXISTING CONCRETE STRUCTURES.

The structural use of existing concrete with a core strength less than 1,500 psi (10.3MPa) is not permitted in rehabilitation work. ~~Such concrete may be strengthened as required for masonry in Section 2114A.~~

For existing concrete structures, sufficient cores shall be taken at representative locations throughout the structure, as designated by the architect or structural engineer, so that knowledge will be had of the in-place strength of the concrete. At least three cores shall be taken from each building for each 4,000 square feet (372 m2) of floor area, or fraction thereof. Cores shall be at least 4 inches (102 mm) in diameter. Cores as small as 2.75 inches (70 mm) in diameter may be allowed by the enforcement agency when reinforcement is closely spaced and the coarse aggregate does not exceed 3/4 inch (19 mm).

Notation [For DSA-SS]:
Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022
Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 – 16023

Notation [For OSHPD]:
Authority: Health and Safety Code Section 129850
Reference: Health and Safety Code Sections 1275, 129850 and 129790